UNITED STATES DEPARTMENT OF THE INTERIOR
U. S. - MEXICO BORDER FIELD COORDINATING COMMITTEE

WATER-RESOURCES ISSUES IN THE RIO GRANDE--RIO CONCHOS TO AMISTAD RESERVOIR SUBAREA

Fact Sheet

INTRODUCTION

In 1994, the U.S. Department of the Interior (DOI) chartered the U.S.-Mexico Border Field Coordinating Committee for the purpose of promoting and facilitating coordination among the DOI bureaus on environmental issues of Departmental interest along the U.S.-Mexico border. One of the foremost issues identified was that of shared-water resources. A multibureau Shared-Water Resources Issues Team was created to identify, compile, and communicate significant issues related to the shared-water resources of the U.S.-Mexico border area. Woodward and Durall (1996), as part of the Issues Team, used surface-water drainage basins as the primary basis for defining and delineating the extent of the border area from a shared-water resources perspective, and divided the border area into eight subareas (fig. 1). This Fact Sheet presents shared-water resources issues along the Rio Grande from its confluence with the Rio Conchos to the Amistad Reservoir and Dam from a DOI perspective.

WATER-RESOURCES ISSUES IDENTIFICATION

The Issues Team surveyed representatives of the various DOI bureaus to identify the significant management and scientific issues associated with shared-water resources in each subarea (fig. 1). The Issues Team acknowledges a number of deficiencies in the issue-identification process in that not all the land owners/managers in the subareas were surveyed: (1) issues were not identified for non-Federal lands, including those managed by the State of Texas or privately owned, and (2) issues have been identified only for the U.S. portion of the subarea, and a comprehensive issue-identification process requires data from Mexico. These deficiencies notwithstanding, the Issues Team has identified a large number of the most pressing issues associated with shared water resources from a DOI perspective. Solicitation of additional input from the States of Texas, Chihuahua, and Coahuila; the Government of Mexico; and private land owners would enhance future efforts to more completely identify shared-water resource issues in the border area.

RIO GRANDE- -RIO CONCHOS TO AMISTAD RESERVOIR SUBAREA

The Rio Grande--Rio Conchos to Amistad Reservoir subarea (fig. 2) encompasses a total of 34,630 square miles (mi^2), of which 13,910 are in Mexico and 20,720 are in the United States. The subarea generally is hot, and the climate varies from semiarid to arid. Average annual rainfall (1961-90) ranged from about 11 inches per year at Presidio, Tex., to about 19 inches per year at the upper elevations of the Chisos Mountains in Big Bend National Park (W.H. Asquith, U.S. Geological Survey, written commun., 1997). This sparsely populated subarea (1990 U.S. population less than 40,000) is predominantly open range and is divided between the Basin and Range and Great Plains physiographic provinces. The Basin and Range province, from Big Bend National Park westward, is characterized by isolated mountain ranges separated by desert basins characteristic of the northern Chihuahuan Desert. Caprock mesas, dry arroyos, and broad alluvial fans are the most prominent features of the Great Plains province.

Surface-water features include the Rio Grande and three major tributaries--Rio Conchos (26,404 mi^2 watershed), Pecos River (35,308 mi^2 watershed), and Devils River (4,305 mi^2 watershed)--the latter two contributing flow directly to Amistad Reservoir. Other surface-water features include springs, ephemeral and intermittent streams, and tinajas (water pockets often below small waterfalls). The Rio Grande flows through deep, steep-walled canyons of limestone, (fig. 3) forming a ribbonlike oasis of riverine and riparian environments and providing a stark comparison to the adjacent desert landscape. The Rio Conchos watershed in its entirety contains almost one-half the entire Rio Grande drainage area in Mexico. For the purpose of this assessment, only that portion of the Rio Conchos watershed downstream from the now discontinued Falomir streamflow-gaging station, near the Luis Leon Dam, is included in this subarea. Similarly, only that portion of the Pecos River watershed downstream from the gaging station at Girvin, Tex., is included in this subarea.

Figure 1. Subareas within the U.S.-Mexico border area.

Within the subarea, both sides of the international border have protected areas. The Maderas del Carmen and Cañon de Santa Elena in Mexico contain nearly 1.2 million acres. Although much of this land is privately held, the Mexican government has given these areas special environmental status. Although much of the land in Texas is privately owned, the National Park Service (NPS) and Texas Parks and Wildlife Department (TPWD) protect significant areas along the border including: Big Bend National Park (NPS), the Rio Grande Wild and Scenic River (NPS), Amistad National Recreation Area (NPS), Black Gap Wildlife Management Area (TPWD), and Big Bend Ranch State Park (TPWD).

SIGNIFICANT WATER-RESOURCE ISSUES

The availability of both surface and ground water is the major water-resources issue in this subarea; concern for its quality is a second important issue. In the United States, ground water is the principal source of water for domestic, livestock, and public-supply uses. In Mexico, the Rio Conchos has historically supplied water for agricultural use. Adequate streamflow, in terms of both annual volume and seasonal distribution of flows and peak discharges, is needed to support aquatic and riparian habitats, satisfy recreational and livestock water uses, and satisfy downstream demands by the U.S. and Mexico for water that is temporarily stored in Amistad Reservoir and allocated for future use to satisfy international agreements.

EXTERNAL FACTORS

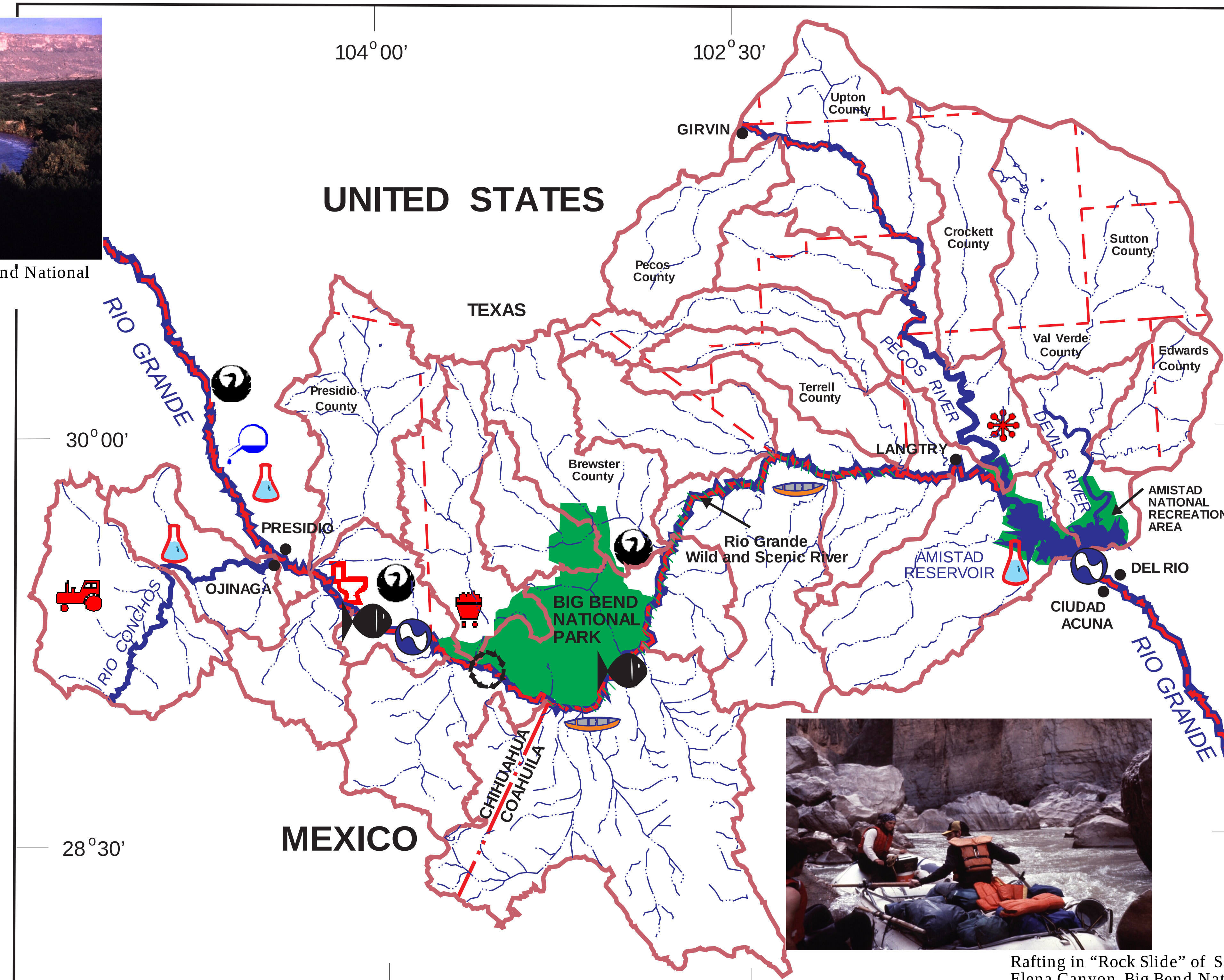
Most of the factors affecting water availability and quality within the subarea originate outside the subarea. The regulation of the Rio Grande is a consequence of laws and treaties governing the allocation of water among the States and between the U.S. and Mexico, which form the fundamental basis for the existing surface-water flow regime in the subarea.

EXPLANATION

The following icons (symbols) are used in the text and in figure 2 to describe a variety of water issues; a brief explanation of each symbol is provided below.

- Water quantity issues
- Ground water-surface water interactions
- Maintenance of river flows
- Riparian/wildlife habitat issues
- Undertreated sewage
- Agricultural chemical/nutrient runoff
- Fish/amphibian impacts
- Mining/tailings dam issues
- Water-quality degradation
- Salinity
- Recreation

Sandbar near Santa Elena. Big Bend National Park. (Photo courtesy of NPS).



Rafting in “Rock Slide” of Santa Elena Canyon. Big Bend National Park.(Photo courtesy D. Prichard).

Figure 2. Water issues in the Rio Grande--Rio Conchos to Amistad Reservoir subarea.

0 10 20 30 40 50 MILES

0 10 20 30 40 50 KILOMETERS

EXPLANATION

- Federal lands
- Federal administrative area
- Boundary of drainage basin

regime in the subarea.

The construction of dams and implementation of flood-control practices, channelization, increased water diversions, and displacement of native cottonwood and willow with tamarisk (salt cedar) have resulted in the Rio Grande becoming seasonally intermittent between Fort Quitman, about 70 miles southeast of El Paso/Ciudad Juarez, and Presidio. On the Rio Grande upstream from the subarea, Elephant Butte and Caballo Reservoirs (in southern New Mexico), impound and release virtually all Rio Grande flows for urban, industrial, and agricultural uses in the El Paso/Ciudad Juarez region. Existing water rights, international treaties, and operational policies administered by the Rio Grande Compact Commission limit Rio Grande flow from this region. The limited return flows to the Rio Grande from these uses have significantly degraded water quality . Those return flows are significantly reduced between Fort Quitman and Presidio as they pass through a reach overgrown with tamarisk and are evapotranspired . This often results in little or no surface flow from the Rio Grande entering the subarea from above the Rio Conchos .

Water-quantity, water-quality, and aquatic-biological characteristics within the subarea are heavily influenced by the Rio Conchos (Davis, 1980). In the Rio Conchos watershed, upstream from the subarea, expanding agricultural, mining, and timber harvesting activities as well as urban and industrial development affect both the quantity and quality of Rio Grande flows through the subarea . The Pecos and Devils Rivers are tributaries to subarea 6 at Amistad Reservoir. The natural discharge of saline ground water into the Pecos River in New Mexico also affects the water quality of Amistad Reservoir (Schertz and others, 1994).

Water Quantity

The availability of streamflows sufficient in variability, magnitude, and duration to protect natural resources that are dependent on these flows is the most serious water-quantity issue in this subarea. If sufficient streamflow is not available to fully support and satisfy all competing water needs, the issue of water quality becomes academic. Prior to 1915, the Rio Grande flowed unimpeded through relatively undisturbed lands in the sparsely populated subarea. At Presidio/Ojinaga, a dramatic change in the river is visible due to the dominating influence of inflow from the Rio Conchos. The Rio Conchos typically supplies the largest percentage of Rio Grande flows allocated by Mexico in accordance with the 1944 Treaty between the U.S. and Mexico. The total annual flow of the Rio Conchos averaged 737,000 acre-feet through the 1980's, more than five times the flow of the Rio Grande measured just above its confluence with the Rio Conchos (International Boundary and Water Commission, 1989). Also, the flood-peak histories of the Rio Grande and Rio Conchos are dramatically different, even though both rivers are heavily regulated.

Dams on the Rio Conchos are operated primarily for water storage. Consequently, the Rio Conchos sometimes experiences high peak flows--71,300 cubic feet per second (cfs) in 1978 and 45,900 cfs in 1991 (Collier and others, 1996). As flood control becomes an issue in the developing Rio Conchos watershed, changes in the annual volume and peak levels of streamflow entering the Rio Grande could affect the long-term maintenance of existing aquatic and riparian habitats and further affect the variability of the flow regime downstream.

Figure 3. Rafting on the Rio Grande near the mouth of Boquillas Canyon, Big Bend National Park (photo courtesy of NPS).

Flow from the Pecos and Devils Rivers' watersheds directly enters Amistad Reservoir (fig. 4). The Rio Grande, which was impounded at Amistad Dam in 1969, has a drainage area of 123,142 mi^2 at the International Boundary and Water Commission (IBWC) streamflow gage located 2.2 miles downstream from the dam. Relative contributions of flow to the reservoir for the period 1968-93 are as follows: the Rio Grande above the Pecos River, about 66 percent (1,836 cfs), the Pecos River, about 11 percent (298 cfs), and the Devils River, about 23 percent (656 cfs), (R.M. Slade, U.S. Geological Survey, written commun., 1997). Mean annual flow from Amistad Reservoir is 2,454 cfs. Although the Devils River watershed is only about 12 percent of the size of the Pecos River watershed, its mean annual flow is more than twice that of the Pecos. Reasons for significant differences in water yields (cfs/mi^2) from the two watersheds are: (1) the Pecos River watershed is mostly arid, whereas the Devils River watershed is mostly semiarid; (2) along much of its length, the Pecos River contains alluvial deposits which allow recharge to ground-water by seepage from the river, whereas the Devils River lies almost entirely within incised limestone canyons, resulting in less ground-water recharge; (3) spring discharge accounts for a higher baseflow for the Devils River, and water diversions for irrigation are greater along the Pecos River.

Ground water is a source of baseflow for streams in the subarea, and its interaction with surface water accounts for differences in water yields between watersheds. The Edwards-Trinity aquifer system (fig. 5) is the principal source of water for domestic, livestock, and public supply east of Big Bend National Park. Although surface water is fully developed, use of water from the Edwards-Trinity aquifer system for irrigation over the subarea is limited due to the poor soils and the generally rocky terrain. In the Big Bend area, ground water occurs in alluvial deposits along the Rio Grande and intermittent streams. These areas provide important sources of water for wildlife and habitat for the endangered Big Bend Gambusia . In some areas sufficient yields can be obtained for domestic, stock, and public-supply uses. Geothermal springs are also a local tourist attraction in Big Bend National Park. River rafting and other forms of recreation are popular along the Rio Grande; contact recreation occurs both in the river and at hot springs along the river's edge in the subarea

Water Quality

Undertreated sewage from Presidio/Ojinaga and border villages, livestock grazing in riparian areas, limited agricultural runoff, mining activities, and atmospheric deposition are factors affecting the water quality of the Rio Grande, Amistad Reservoir, and Rio Grande tributaries within the subarea.

The data base available reveals the presence of toxic contaminants and elevated densities of fecal-coliform bacteria. These data represent a compilation of water-quality data for stream sites sampled by the Texas Natural Resources Conservation Commission (TNRCC), U.S. Section of the IBWC, and U.S. Geological Survey (USGS). The TNRCC periodically assesses available data and has identified several constituents of concern in the subarea: arsenic, cadmium, chromium, copper, lead, mercury, nitrogen, phosphorus, selenium, silver, zinc, DDD, DDE, DDT, dieldrin, endrin, hexachlorobenzene, PCB's, and total PAH's (Texas Water Commission, 1992a, 1992b; Texas Natural Resource Conservation Commission, 1994a, 1994b) . The TNRCC has designated the Rio Grande upstream from Langtry (TNRCC Segment 2306) for public-water supply; contact recreation; and high-quality, aquatic-habitat protection (Texas Natural Resources Conservation Commission, 1995).

Except for atmospheric deposition, the largest potential sources of toxic contaminants are upstream rather than within the subarea. These point and nonpoint sources of toxic contaminants include agricultural runoff and irrigation return flows in the upstream watershed areas of the Rio Grande and Rio Conchos; drainage from past and current mining activities in the upstream watershed area of the Rio Conchos and from past underground mining for mercury in Big Bend National Park and near Terlingua; and urban runoff and treated and untreated municipal and industrial wastewater from metropolitan areas, such as El Paso/ Ciudad Juarez and Chihuahua.

Surface-water-quality data needed to fully quantify the effects of these factors, both within and upstream from the subarea, are limited as is information pertaining to the condition of biological resources and aquatic habitats. Particularly limited are data needed to characterize spatial and temporal occurrence, distribution, and trends of toxic constituents, such as trace elements, pesticides, and industrial organic compounds in water, sediment, and biological tissue. However, recent binational sampling surveys (Texas Natural Resources Conservation Commission, 1994c) and research activities designed to assess the level of toxic contaminants in reservoir sediments (Van Metre and others, 1997) are beginning to provide some insight into existing water-quality conditions as well as identify water-quality concerns within the subarea.

In the late 1980's, Bestgen and Platania (1988) conducted a survey of fish and aquatic habitats in the upper portion of the subarea (from upstream of the Rio Conchos to Big Bend National Park) and compared their results with an earlier fisheries survey conducted by Hubbs and others (1977). A comparison of data from these surveys indicated that the density and diversity of fish populations in the Rio Grande downstream from the Rio Conchos have decreased markedly since 1977, possibly due to a decline in water quality (Bestgen and Platania, 1988).

Figure 4. International Amistad Reservoir near Rough Canyon (photo courtesy of NPS).

Irwin (1989) reported the presence of DDT, DDD, and DDE in fish and wildlife sampled from the Rio Grande within Big Bend National Park. The results of a more recent binational study of toxic contaminants in the Rio Grande and its tributaries further define the occurrence and spatial distribution of toxic constituents in water, sediment, and biological tissue. The binational study team initially reviewed available historical data for the Rio Grande in the reach that extends from the confluence of the Rio Conchos to 10 miles downstream (Texas Natural Resources Conservation Commission, 1994c). This retrospective analysis indicates that in the late 1970's elevated concentrations of DDT, DDD, DDE, endrin, dieldrin, and PCB's in bottom sediment and fish tissue existed. The source of the contaminants, in particular DDE and DDT, was identified as primarily from the Rio Conchos watershed. Data for the 1980's indicates that concentrations of these constituents in the Rio Grande had decreased substantially, but in 1992, the TNRCC (1994c) reported the possibility that top predators such as the peregrine falcon may be moderately affected through accumulation and biomagnification of pesticide residues .

The binational study team conducted the first synoptic main-stem sites in the study area, with potential effects more prevalent at tributary sites. The assessment assigned "slight" to "moderate" potential for toxic chemical effects in the Rio Grande upstream from Presidio, Tex., as well as a "slight" to "moderate" potential for toxic chemical effects near the mouth of the Rio Conchos. A more focused assessment (Phase II) for areas exhibiting the highest potential for toxic chemical effects is scheduled for publication in 1998.

Extremely high rates of siltation in Amistad Reservoir near the confluence of the Rio Grande and Pecos River are a concern of the NPS. The extreme siltation has made sections of the rivers virtually impassable and has helped establish extensive stands of tamarisk within the conservation pool area of the reservoir. The USGS has conducted studies addressing surface-water-quality trends and potential sediment contamination for selected constituents in this reach of the Rio Grande. The most recent study (Van Metre and others, 1997) defined historical changes in surface-water quality in the Rio Grande Basin by analyzing changes in sediment chemistry in cores from three reservoirs, including Amistad Reservoir. The study reveals that bottom sediments in the reservoir contain relatively low concentrations of industrial organic contaminants. The remarkably high sedimentation rates in the reservoir effectively dilute the load of anthropogenic contaminants associated with sediments. Total DDT concentrations decreased in sediments deposited from the 1970's to 1997. Concentrations of eight trace elements increased in the sediment core from the Rio Grande arm, and six of eight increased in the Devils River arm. All eight are associated with atmospheric sources including solid-waste incineration and power-plant emissions.

Schertz and others (1994) reported increasing trends in concentrations of dissolved sulfate, chloride, and dissolved solids for the period 1975-89, at the Rio Grande near Langtry, the Pecos River near Langtry, and downstream from Amistad Reservoir. Concentrations of dissolved solids are about 750, 1,800, and 200 milligrams per liter in the Rio Grande near Langtry, in the main stem of the Pecos River, and in the Devils River, respectively. The increasing trends in the Rio Grande downstream from Amistad Reservoir primarily are a result of increasing trends in the Pecos River and, to a lesser extent, in the Rio Grande upstream from the Pecos River.

In Big Bend National Park, wells completed in the alluvium along the Rio Grande at the Castolon Area produce water not suitable for public supply. The ground water contains large concentrations of fluoride, sulfates, and dissolved solids; the water pumped from the supply wells probably is a combination of ground water from adjacent aquifers and infiltration of water from the Rio Grande (National Park Service, 1996).

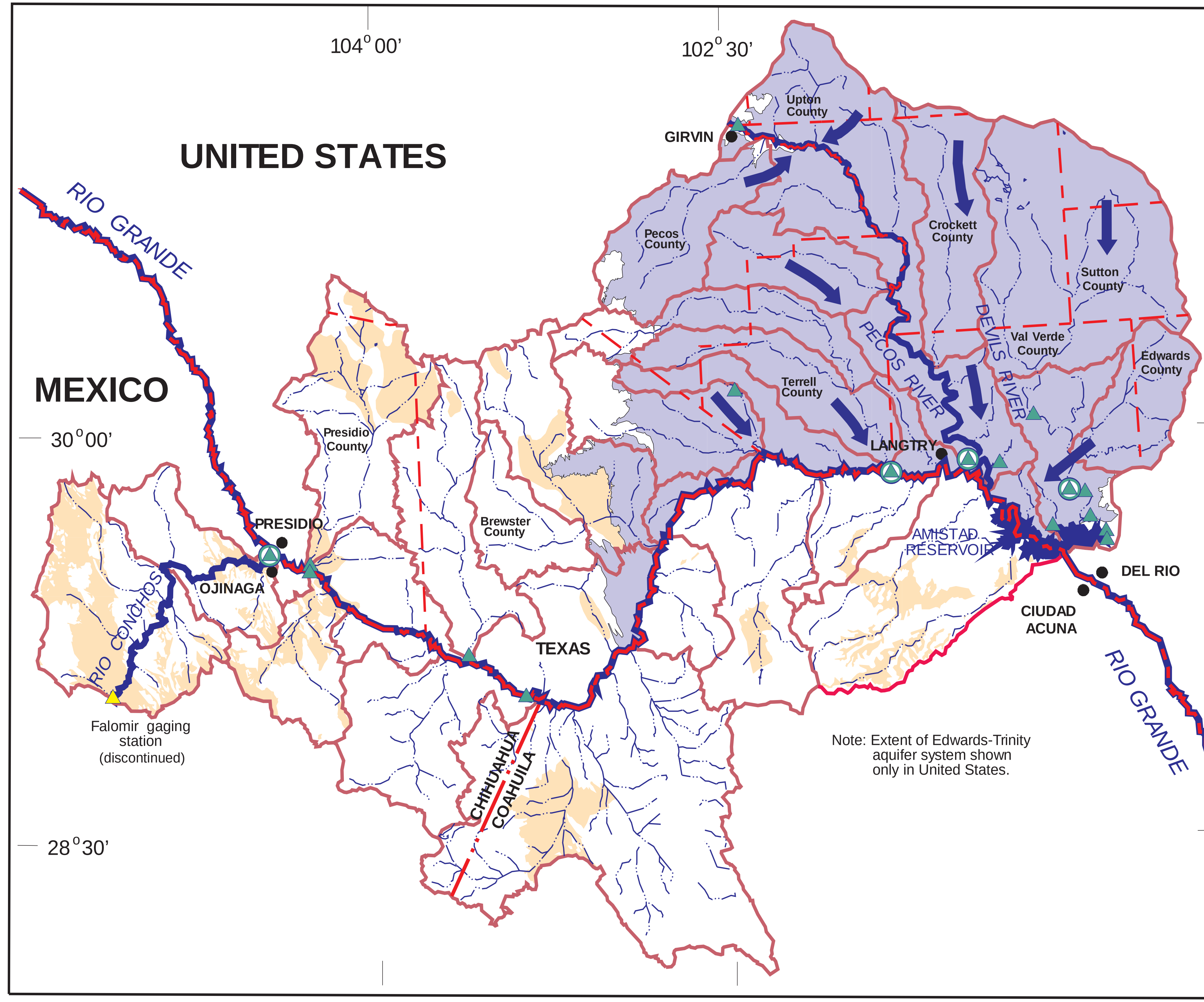
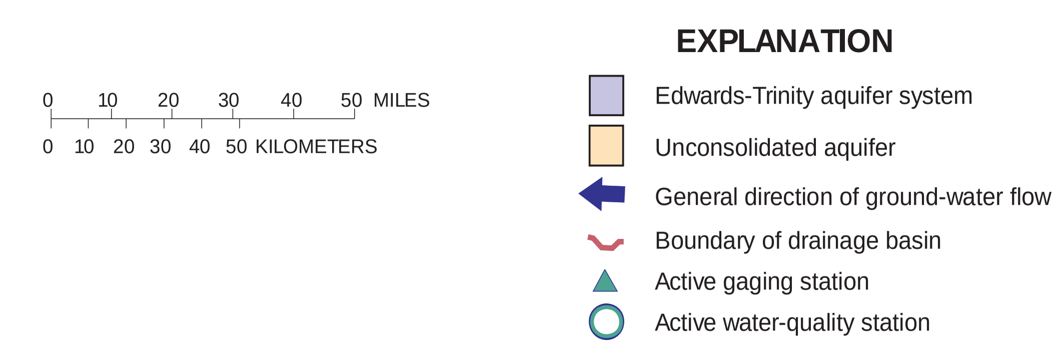


Figure 5. Generalized hydrolologic information in the Rio Grande--Rio Conchos to Amistad Reservoir subarea.



CONSIDERATIONS FOR FUTURE ACTION

Water resources are critical to the health of the communities and the environment along each side of the border within the Rio Grande--Rio Conchos to above Amistad Reservoir subarea. The availability and development of limited water supplies, the use of the water, and the resultant environmental consequences of water development and use have largely defined the historical and cultural context of the region. The Rio Grande in this subarea has been not so much an international boundary as a defining element of a unique regional culture of border peoples. The management of this important resource, as well as the equitable resolution of present and future conflicts, is of concern to all DOI bureaus operating within this and adjacent subareas. Therefore, the continued cooperation among the DOI bureaus is necessary to understand and appropriately interact with the Government of Mexico as well as other Federal, State, and local entities and citizens groups, in order to address the many complex issues relating to shared-water resources.

Suggested actions from the DOI perspective include:

- Ensuring that sufficient current water-quantity, water-quality, and aquatic-biological data are readily available (including Internet availability) to assess water-resources status and trends;
- Facilitating increased cooperation and collaboration between the Government of Mexico; the States of Chihuahua, Coahuila, and Texas; and the DOI bureaus in addressing transboundary water issues affecting lands managed by the DOI;
- Recognizing the ecological, cultural, financial, and scenic values of aquatic, riparian, and recreation resources and managing Federal land in a manner that will assure biological integrity, provide recreational opportunity, and support habitat for aquatic and other wildlife communities;
- Developing an improved understanding of existing water uses and the effects of those uses on threatened and endangered species, riparian habitat and other water-dependent resources, and recreational opportunities;
- Managing DOI lands in a manner that minimizes adverse effects on water and water-dependent resources through implementation of water conservation, sustainable development, and public education; and
- Promoting public awareness of the importance of water and water-dependent resources.

The continued importance of border resource issues to the DOI is evidenced by its recent participation in the development of the Border XXI Program, a conceptual plan for binational cooperation in the transboundary region (U.S. Environmental Protection Agency, 1996).

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